

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of:

HAREN S. GANDHI ET AL.

Serial No.: 10/065,497

Filed: October 24, 2002

For: CATALYST SYSTEM FOR LEAN BURN ENGINES

Attorney Docket No.: FCHM 0104 PUS

Group Art Unit: 1725

Examiner: Jonathan J. Johnson

**APPEAL BRIEF UNDER 37 C.F.R. § 41.37**

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U.S. Patent & Trademark Office  
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Alexandria, VA 22313-1450

Sir:

This is an Appeal Brief in support of the appeal from the final rejection of claims 1-20, 31 and 32 of the Office Action mailed on October 24, 2006 for the above-identified patent application.

**I. REAL PARTY IN INTEREST**

The real party in interest is Ford Global Technologies, LLC ("Assignee"), a corporation organized and existing under the laws of the state of Delaware, and having a place of business at One Parklane Blvd., Suite 600 East, Dearborn, Michigan 48126, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on January 7, 2003 at Reel 013336/Frame 0605.

## **II. RELATED APPEALS AND INTERFERENCES**

There are no appeals or interferences known to the Appellant, the Appellant's legal representative, or the Assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

## **III. STATUS OF CLAIMS**

Claims 1-20 and 31-32 are pending in this application. Claims 1-20 and 31-32 have been rejected and are the subject of this appeal.

## **IV. STATUS OF AMENDMENTS**

An amendment after final rejection was filed on January 24, 2007 and has been denied entry.

## **V. SUMMARY OF CLAIMED SUBJECT MATTER**

The invention is directed to a catalyst system for use with internal combustion engines to reduce noxious emissions when the engine is operated at both lean and stoichiometric air/fuel ratios. In one embodiment, the catalyst system of this invention includes two catalysts. One of the catalysts is a lean NOx trap designed specifically to store NOx emissions under lean conditions, reduce the stored NOx during rich operation and convert HC, CO and NOx under stoichiometric operation. This catalyst consists of two zones — a front cerium-free zone containing aluminum oxide, oxides of alkali metals, alkaline earth metals and a high loading of precious metals, and a second zone of oxides of aluminum, alkali metals, alkaline earth metals, rare earth metals, or combinations thereof, and a lower loading of precious metals. For this catalyst, the entire front zone is positioned upstream of the second zone. The second catalyst is designed specifically to optimize the conversion of HC, CO and NOx under stoichiometric operations. The second catalyst also stores any NOx emitted from the first catalyst during lean operation and converts the stored NOx during the rich purges. The second catalyst contains precious metals, aluminum oxides and a higher concentration of

mixed oxides of zirconium and cerium and alkali metals or alkaline earth metals such as barium oxide or magnesium oxide.

The first catalyst is a lean NO<sub>x</sub> trap, that solves the prior art problem of 1) “NO<sub>x</sub> release,” the release of unreduced NO<sub>x</sub> from the NO<sub>x</sub> trap during the transition from lean to rich conditions; and 2) fuel economy reduction that results from frequent purges of the NO<sub>x</sub> trap. The specific selection of materials in the front zone of the first catalyst minimizes the oxygen storage function and thus the NO<sub>x</sub> release is minimized and in turn the fuel required to purge the catalyst. More specifically, the first zone of the first catalyst includes a catalyst material PM-Rh, and a metal oxide selected from the group consisting of oxides of aluminum, alkali metals, alkaline-earth metals, and combinations thereof — the first zone is devoid of cerium. Reduction of oxygen storage capacity of the lean NO<sub>x</sub> trap is believed to reduce NO<sub>x</sub> release during the lean-rich transition. Accordingly, in the claimed invention, the first zone must be devoid of cerium. As set forth in the specification on page 11, “catalyst system 10 minimizes the oxygen storage function in the front zone of the first catalyst, so that NO<sub>x</sub> release is minimized. The reduction of oxygen storage function in the front zone is also believed to minimize the fuel required to purge the catalyst.”

In another embodiment, a single catalyst includes a first zone for optimizing the reduction of hydrocarbon, NO<sub>x</sub> and CO emissions under stoichiometric air/fuel ratios, and a second NO<sub>x</sub> trapping zone for optimizing NO<sub>x</sub> reductions under lean air/fuel ratios. In yet another embodiment, a single catalyst includes a first zone for optimizing the reduction of hydrocarbon, NO<sub>x</sub> and CO emissions under stoichiometric air/fuel ratios, a second NO<sub>x</sub> trapping zone for optimizing NO<sub>x</sub> reductions under lean air/fuel ratios, and a third zone to suppress hydrogen sulfide.

Independent claim 1 recites a catalyst system for use in reducing emissions from an exhaust gas stream containing hydrocarbons, CO and NO<sub>x</sub> that comprises a first lean NO<sub>x</sub>

trapping catalyst for optimizing the storage of NOx emissions under lean/air fuel ratios, the catalyst system includes a first cerium-free zone positioned entirely upstream of the second zone; and a second catalyst for optimizing the reduction of hydrocarbon, NOx and CO emissions under stoichiometric air/fuel ratios. Claims 2-20 depend from independent claim 1.

Independent claim 31 recites a catalyst for use with an internal combustion engine to provide emission reductions, the catalyst comprises a first zone for optimizing the reduction of hydrocarbon, NOx and CO emissions under stoichiometric air/fuel ratios, and a second NOx trapping zone for optimizing NOx reductions under lean air/fuel ratios, wherein the entire first zone is positioned upstream of the second zone, the second zone is a cerium-free zone and further wherein the first and second zone are contained within a single catalyst structure.

Independent claim 32 recites a catalyst for use with an internal combustion engine to provide emission reductions, that comprises a first zone for optimizing the reduction of hydrocarbon, NOx and CO emissions under stoichiometric air/fuel ratios, a second NOx trapping zone for optimizing NOx reductions under lean air/fuel ratios and a third zone that comprises a hydrogen sulfide suppressant, wherein the entire first zone is positioned upstream of the second zone, the second zone is a cerium-free zone and further wherein the first and second zone are contained within a single catalyst structure.

#### **VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

Claims 1-20 and 31-32 are rejected under 35 U.S.C. § 102(b) as being anticipated by Sung. et al, U.S. Patent No. 6,087,298.

Claim 31 is rejected under 35 U.S.C. § 102 (b) as being anticipated by EP 1108863. Claim 31 is also rejected under 35 U.S.C. § 102(e) as being anticipated by Deeba et al., U.S. Patent No. 6,375,910.

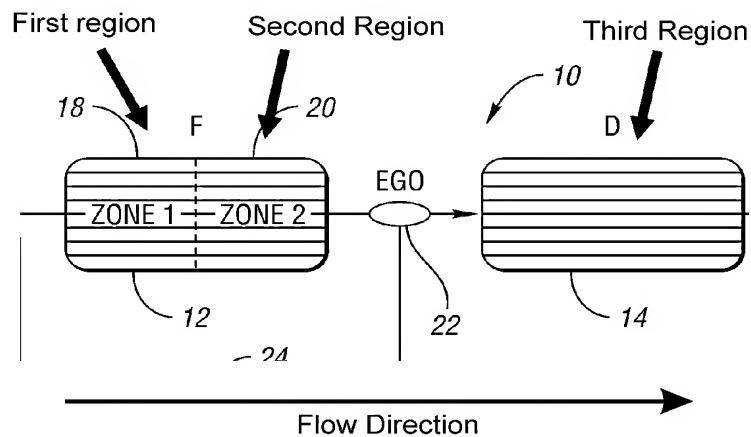
Finally, claims 1-20 and 31-32 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Sung et al., U.S. Patent No. 6,987,298.

## **VII. ARGUMENT**

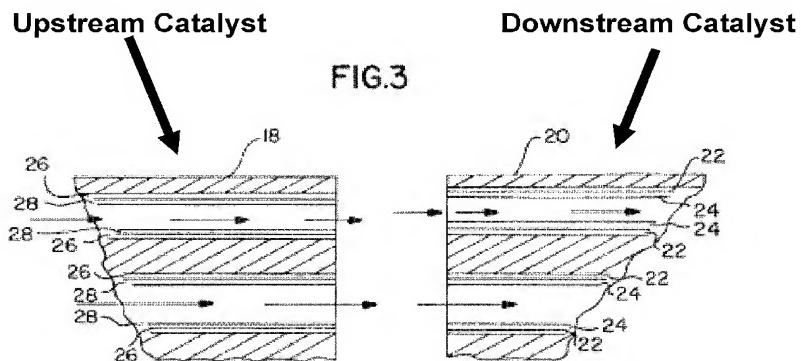
### **1. Claims 1-20 And 31-32 Are Patentable Under 35 U.S.C. § 102 Over U.S. Patent No. 6,087,298**

Claims 1-20 and 31-32 are rejected under 35 U.S.C. § 102(b) as being anticipated by Sung. et al, U.S. Patent No. 6,087,298.

The present invention is characterized by three distinct regions sequentially arranged — a first zone of a NO<sub>x</sub> trapping catalyst (first region), a second zone of NO<sub>x</sub> trapping catalyst (second region), and a second catalyst for optimizing the reduction (third region). The sequential nature of these regions are ensured by the limitation “wherein the entire first zone is positioned upstream of the second zone.” In an effort to illustrate the relationship of the 3 regions, the relevant section of Figure 3 of the present invention is reproduced below with the three sequential regions labeled as is the flow direction:



Sung et al. does not disclose the entire first zone positioned upstream of the second zone as required by claims 1, 31 and 32. This is evident by inspection of Figure 3 from Sung et al. which is reproduced below with a label added for the upstream and downstream catalysts:



Clearly, Sung et al. only shows two sequentially arranged regions. Two regions are not the same as three regions. The Examiner attempts to remedy this glaring deficiency by pointing to the layered nature of the upstream and downstream catalysts. However, the limitation "wherein the entire first zone is positioned upstream of the second zone" precludes the application of such a construction to independent claims 1, 31 and 32 since Sung et al. does not disclose such an arrangement of the layers.

Applicants have clearly shown that there is a difference between a zoned structure as claimed in the present invention and a layered structure as used in Sung et al. Figure 3 of the present application illustrates a zoned structure in which one zone is entirely upstream of the other zone. Figure 3 of Sung et al. illustrates what is meant by layered in the context of the invention disclosed in that reference. Moreover, the Specification of the present invention leaves no doubt that a zoned construction is different from a layered construction:

The forward catalyst 12 consists of two zones 18, 20. It should be noted that this invention also contemplates the use of layers in place of zones.

(Specification, paragraph 31.)

Clearly, this language illustrates that a zoned construction is not a layered construction. Although Applicants state that layers may be substituted for zones, Applicants have not claimed layers which is a different invention. It should be appreciated that one fundamental difference between a layered structure and a zoned structure is that gases must diffuse through upper layers in order to reach lower layers. In a zoned construction, in which a first layer is positioned upstream of a second layer, exhaust gases necessarily passed over each zone without having to rely on diffusion to reach the second zone.

Since Sung et al. cannot and does not disclose a first zone up stream of a second zone as required by amended claim 1, independent claim 1 cannot be rejected under 35 U.S.C. § 102 (b) since anticipation requires “each and every element of the claimed invention be disclosed in the prior art.” *Akzo N.V. v. United States Int'l Trade Comm'n*, 1 USPQ 2d 1241, 1245 (Fed. Cir. 1986). Accordingly, claims 1-20, 31 and 32 are allowable under 35 U.S.C. § 102 (b) over Sung et al.

## **2. Claim 31 Is Patentable Under 35 U.S.C. § 102 (b) Over EP 108863**

EP 1108863 does not disclose the sequential arrangement of a first and second zone on a single catalyst. The Examiner clearly states in sustaining the rejection, that two **distinct** catalysts are being combined together to provide the functionality of independent claim 31. Applicants had previously amended claim 31 to clarify that the first and second zones must be contained within a single catalyst structure. Clearly, the use of one catalyst as compared to two distinct catalysts is a significant fabrication advantage. Accordingly, claim 31 is allowable under 35 U.S.C § 102 (b) over EP 1108863.

**3. Claim 31 Is Patentable Under 35 U.S.C. § 102(e) Over Deeba et al., U.S. Patent No. 6,375,910**

Claim 31 is patentable under 35 U.S.C. § 102(b) for precisely the same reasons stated above for EP 1108863. Specifically, the Examiner again has combined two **distinct** catalysts together to create the two-zone single catalyst structure of the present invention. Accordingly, amended claim 31 is allowable under 35 U.S.C. § 102(b) over U.S. Patent No. 6,375,910.

**4. Claims 1-20 And 31-32 Are Patentable Under 35 U.S.C. § 103 Over U.S. Patent No. 6,067,298**

Claims 1-20 and 31-32 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Sung et al., U.S. Patent No. 6,987,298.

The allowability of claims 1-20, 31 and 32 over the Sung et al. reference has been discussed above. The Examiner only rejects these claims under 35 U.S.C. § 103(a) “[i]f it is considered that the disclosure of Sung et al. is not sufficiently specific to constitute anticipation. . . .” However, as set forth above, Sung et al. fails to disclose the limitation — “wherein the **entire** first zone is positioned upstream of the second zone.”

Accordingly, claims 1-20, 31 and 32 are allowable under 35 U.S.C. § 103(a) over Sung et al.

The fee of \$500 as applicable under the provisions of 37 C.F.R. § 41.20(b)(2) is being charged to Deposit Account No. 06-1510 of Ford Global Technologies, LLC concurrently with the e-filing of this Appeal Brief. Please charge any additional fee or credit any overpayment in connection with this filing to Ford Global Technologies, LLC Deposit Account No. 06-1510.

Respectfully submitted,

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Enclosure - Appendices

### **VIII. CLAIMS APPENDIX**

1. A catalyst system for use in reducing emissions from an exhaust gas stream containing hydrocarbons, CO and NOx comprising:

a first lean NOx trapping catalyst for optimizing the storage of NOx emissions under lean air/fuel ratios, comprising a first zone and a second zone, wherein the entire first zone is positioned upstream of the second zone;

said first zone comprising a) a catalyst mixture PM-Rh, where PM is a catalyst material selected from the group consisting of Pt, Pd and combinations thereof, and b) a metal oxide selected from the group consisting of oxides of aluminum, alkali metals, alkaline-earth metals, and combinations thereof, wherein said first zone is devoid of cerium;

said second zone comprising a) a catalyst mixture PM-Rh, where PM is a catalyst material selected from the group consisting of Pt, Pd and combinations thereof, and b) a metal oxide selected from the group consisting of alkali metals, alkaline earth metals, rare earth metals and combinations thereof; and

a second catalyst for optimizing the reduction of hydrocarbon, NOx and CO emissions under stoichiometric air/fuel ratios comprising: a) a catalyst mixture PM-Rh, where PM is a catalyst material selected from the group consisting of Pt, Pd and combinations thereof, b) a metal oxide selected from the group consisting of oxides of aluminum, alkali metals, alkaline earth metals and combinations thereof, and c) a metal oxide selected from the group consisting of oxides of zirconium, cerium and combinations thereof.

2. The catalyst system of claim 1, wherein said second zone of said first catalyst further comprises zirconium oxide.

3. The catalyst system of claim 1, wherein said second catalyst further comprises hydrogen sulfide emission suppressants.

4. The catalyst system of claim 1, wherein said second catalyst further comprises nickel oxide.

5. The catalyst system of claim 1, wherein said Rh in said first catalyst is placed on ZrO<sub>2</sub> particles of 3-5% (wt).

6. The catalyst system of claim 1, wherein said catalyst mixtures of said first and second catalysts are coated on an alumina substrate.

7. The catalyst system of claim 6, wherein said alumina substrate in said first zone is stabilized by between 1-8% (wt) La<sub>2</sub>O<sub>3</sub>.

8. The catalyst system of claim 6, wherein said alumina substrate in said second catalyst is stabilized by 2-15% (wt) BaO.

9. The catalyst system of claim 1, wherein said first zone of said first catalyst further comprises a metal oxide selected from the group consisting of barium oxide, magnesium oxide, potassium oxide and combinations thereof, wherein the metal oxide comprises 2-15% (wt).

10. The catalyst system of claim 1, wherein said second zone of said first catalyst further comprises a metal oxide selected from the group consisting of barium oxide, magnesium oxide and combinations thereof.

11. The catalyst system of claim 10, wherein said second zone of said first catalyst comprises BaO and MgO of 10-40% (wt).

12. The catalyst system of claim 1, wherein said catalyst mixture PM-Rh in said first zone of said first catalyst comprises Pt and Rh in a ratio of between 5:1 and 25:1.

13. The catalyst system of claim 1, wherein said catalyst mixture PM-Rh in said first zone of said first catalyst has a loading of between 60-300 g/ft3.

14. The catalyst system of claim 1, wherein said second zone of said first catalyst comprises Pt and Rh in a ratio of between 1:1 and 10:1.

15. The catalyst system of claim 1, wherein said catalyst mixture PM-Rh in said second zone of said first catalyst has a loading of between 10-100 g/ft3.

16. The catalyst system of claim 1, wherein said catalyst mixture PM-Rh in said second catalyst comprises Pt and Rh in a ratio of between 5:1 and 15:1.

17. The catalyst system of claim 1, wherein said catalyst mixture PM-Rh in said second catalyst has a loading of between 10-120 g/ft3.

18. The catalyst system of claim 1, wherein PM-Rh in said second catalyst comprises Pt and Rh placed on Ce and Zr particles of 5-30% (wt) wherein the molar ratio of Ce and Zr is 50:50.

19. The catalyst system of claim 1, wherein said first catalyst and said second catalyst are close-coupled, said first catalyst being positioned in a forward position and said second catalyst being positioned in a downstream position.

20. The catalyst system of claim 1, wherein an exhaust gas sensor is placed between said first and second catalysts.

31. A catalyst for use with an internal combustion engine to provide emission reductions, comprising:

a first zone for optimizing the reduction of hydrocarbon, NOx and CO emissions under stoichiometric air/fuel ratios and a second NOx trapping zone for optimizing NOx reductions under lean air/fuel ratios, wherein the entire first zone is positioned upstream of the second zone and wherein the first zone and the second zone are contained within a single catalyst structure;

said first zone comprising a) a catalyst mixture PM-Rh where PM is a catalyst material selected from the group consisting of Pt, Pd and combinations thereof, and b) a metal oxide selected from the group consisting of cerium, zirconium and combinations thereof; and

said second zone comprising a) a catalyst mixture PM-Rh, where PM is a catalyst material selected from the group consisting of Pt, Pd and combinations thereof; and b) a metal selected from the group consisting of oxides of aluminum, alkali metals, alkaline earth metals and combinations thereof, wherein said second zone is devoid of cerium to minimize the release of unreduced NOx.

32. A catalyst for use with an internal combustion engine to provide emission reductions, comprising:

a first zone for optimizing the reduction of hydrocarbon, NOx and CO emissions under stoichiometric air/fuel ratios, a second NOx trapping zone for optimizing NOx reduction under lean air/fuel ratios, and a third zone to minimize hydrogen sulfide emissions, said first zone comprising a) a catalyst mixture PM-Rh where PM is a catalyst mixture selected from the group consisting of Pt, Pd and combinations thereof, and b) a metal oxide selected from the group consisting of cerium, zirconium and combinations thereof;

said second zone comprising a) a catalyst mixture Pm-Rh, where PM is a catalyst material selected from the group consisting of Pt, Pd and combination thereof; and b) a metal selected from the group consisting of oxides of aluminum, alkali metals, alkaline earth metals and combinations thereof, wherein said second zone is devoid of cerium, wherein the

entire first zone is positioned upstream of the second zone and wherein the first zone and the second zone are contained within a single catalyst structure; and

    said third zone comprising a) a hydrogen sulfide suppressant, b) a catalyst mixture PM-Rh where PM is a catalyst material selected from the group consisting of Pt, Pd and combinations thereof, and c) a metal oxide selected from the group consisting of cerium, zirconium and combinations thereof.

**IX. EVIDENCE APPENDIX**

None.

**X. RELATED PROCEEDINGS APPENDIX**

None.